

Claims

[c1] 1. A transmission for a hybrid electric vehicle comprising:
an input shaft with a main transmission fluid pump drivingly connected thereto;
an electronically controlled hydraulic shift system;
a low-reverse clutch and a forward clutch connected to the hydraulic shift system;
an electronically driven fluid pump; and
a shut down shuttle valve operatively engaging the electronically driven fluid pump, the low/reverse clutch and the forward clutch and switchable to selectively engage and disengage the electronically driven pump from the hydraulic shift system.

[c2] 2. The transmission of claim 1 further including a forward-reverse solenoid and a forward-reverse shuttle, and the shut down shuttle has a first position where the forward-reverse solenoid and forward reverse shuttle are exposed to fluid pressure from the main transmission fluid pump and a second position where the forward-reverse solenoid and forward-reverse shuttle are exposed to fluid pressure from the electronically driven fluid pump.

[c3] 3. The transmission of claim 2 wherein the shut down shuttle is shiftable from the first position to the second position when the fluid pressure produced by the electronically driven fluid pump exceeds the fluid pressure produced by the main transmission fluid pump.

[c4] 4. The transmission of claim 3 wherein the shut down shuttle is shiftable from the second position to the first position when the fluid pressure produced by the electronically driven fluid pump is less than the fluid pressure produced by the main transmission fluid pump.

[c5] 5. The transmission of claim 4 wherein the electronically driven pump includes a fluid output and wherein the transmission further includes a pressure transducer operatively engaging the fluid output.

[c6] 6. The transmission of claim 2 wherein the shut down shuttle is shiftable from the second position to the first position when the fluid pressure produced by

the electronically driven fluid pump is less than the fluid pressure produced by the main transmission fluid pump.

[c7] 7. The transmission of claim 1 wherein the electrically driven pump includes a fluid output and wherein the transmission further includes a pressure transducer operatively engaging the fluid output.

[c8] 8. The transmission of claim 7 further including a second pressure transducer operatively engaging the forward clutch.

[c9] 9. The transmission of claim 7 further including a controller in communication with the pressure transducer, and a solid state relay electronically connected to and drivable by the controller, and with the electronically driven pump electronically connected to and drivable by the solid state relay.

[c10] 10. A hybrid powertrain for a vehicle comprising:
an internal combustion engine;
a traction motor drivingly connected to the engine; and
a transmission having an input shaft, with a main transmission fluid pump drivingly connected thereto, and an electronically controlled hydraulic shift system, and including a low-reverse clutch and a forward clutch connected to the hydraulic shift system, and with an electronically driven fluid pump, and with a shut down shuttle valve operatively engaging the electronically driven fluid pump, the low/reverse clutch and the forward clutch and switchable to selectively engage and disengage the electronically driven pump from the hydraulic shift system.

[c11] 11. The hybrid powertrain of claim 10 further including a forward-reverse solenoid and a forward-reverse shuttle, and the shut down shuttle has a first position where the forward-reverse solenoid and forward reverse shuttle are exposed to fluid pressure from the main transmission fluid pump and a second position where the forward-reverse solenoid and forward-reverse shuttle are exposed to fluid pressure from the electronically driven fluid pump.

[c12] 12. The hybrid powertrain of claim 11 wherein the shut down shuttle is shiftable from the first position to the second position when the fluid pressure produced

by the electronically driven fluid pump exceeds the fluid pressure produced by the main transmission fluid pump.

[c13] 13. The hybrid powertrain of claim 10 wherein the electrically driven pump includes a fluid output and wherein the transmission further includes a pressure transducer operatively engaging the fluid output.

[c14] 14. The hybrid powertrain of claim 13 further including a controller in communication with the pressure transducer, and a solid state relay electronically connected to and drivable by the controller, and with the electronically driven pump electronically connected to and drivable by the solid state relay.

[c15] 15. A method of operating a hydraulic system in an automatic transmission of a hybrid electric vehicle, with the transmission including an input shaft and a main pump for generating pressure in a hydraulic fluid when the input shaft is rotating, the method comprising the steps of:
detecting that a rotational velocity of the transmission input shaft is below a predetermined threshold, and that a gear shift is in one of a drive and a low position;
actuating an auxiliary pump to boost a pressure of the hydraulic fluid;
operating the auxiliary pump to increase the hydraulic fluid pressure to a desired line pressure;
hydraulically connecting the auxiliary pump to a low-reverse clutch and a forward clutch; and
hydraulically disconnecting the main pump from the low-reverse clutch and the forward clutch.

[c16] 16. The method of claim 15 further including, measuring the line pressure of the hydraulic fluid coming from the auxiliary pump, and adjusting the auxiliary pump operation based on the measured line pressure in order to maintain the desired line pressure.

[c17] 17. The method of claim 15 wherein the step of adjusting the auxiliary pump operation includes, communicating the measured line pressure to a controller.

adjusting and sending a pulse width modulated signal from the controller to a steady state relay to thereby adjust a speed of the auxiliary pump.

- [c18] 18. The method of claim 15 further including, detecting when the rotational velocity of the transmission input shaft rises above a second predetermined threshold, and deactivating the auxiliary pump when the transmission input shaft is detected as rising above the second predetermined threshold.
- [c19] 19. The method of claim 15 further including, detecting if the gear shift is no longer in one of the drive and the low positions, and deactivating the auxiliary pump when the gear shift is no longer in one of the drive and the low positions.
- [c20] 20. The method of claim 15 wherein the step of hydraulically connecting the auxiliary pump includes moving a shut down shuttle valve from a first position to a second position.